

dihydroxyimino compound, a diazadihydroxyimninalkyldecadiene, a diazadihydroxyiminodialkylundecadiene, a tetraazatetraalkylcyclotetradecatetraene, a tetraazatetraalkylcyclododecatetraene, a bis(difluoroboryl) diphenyl glyoximate, a bis(difluoroboryl) dimethyl glyoximate, a N,N'-bis(salicylidene)ethylenediamine, a dialkyldiaza-dioxodialkyldecadiene, or a dialkyldiazadioxodialkyltridecadiene. Low molecular weight methacrylate macromers may also be prepared with a pentacyanocobalt(II) catalytic chain transfer agent as disclosed in U.S. Patent 4,722,984.

b2 Illustrative macromers using this approach are methacrylate polymers with acrylates or other vinyl monomers wherein the polymers or copolymers have a terminal ethylenic group and a hydrophilic functional group. Preferred monomer components for use in preparing macromers include: tertiary-butyl methacrylate (tBMA), tertiary-butyl acrylate (tBA), methyl methacrylate (MMA); ethyl methacrylate (EMA); butyl methacrylate (BMA); 2-ethylhexyl methacrylate; methyl acrylate (MA); ethyl acrylate (EA); butyl acrylate (BA); 2-ethylhexyl acrylate; 2-hydroxyethyl methacrylate (HEMA); 2-hydroxyethyl acrylate (HEA); methacrylic acid (MAA); acrylic acid (AA); esters of acrylic and methacrylic acid wherein the ester group contains from 1 to 18 carbon atoms; nitriles and amides of acrylic and methacrylic acid (e.g., acrylonitrile); glycidyl methacrylate and acrylate; itaconic acid (IA) and itaconic acid anhydride (ITA), half ester and imide; maleic acid and maleic acid anhydride, half ester and imide; aminoethyl methacrylate; t-butyl aminoethyl methacrylate; dimethyl aminoethyl

On page 8, line 31 amend as follows:

B3 Each constituent linear backbone segment and/or branch segment of the branched polymer of this invention may contain a variety of functional groups. A "functional group" is considered to be any moiety capable of being attached to a backbone segment or a branch segment by a direct valence bond or by a linking group. Illustrative of functional groups which can be borne by the backbone segment or the branch segments are -COOR; -OR; -SR (where R can be hydrogen, alkyl or cycloalkyl of 1-12 carbon atoms, aryl, alkaryl or aralkyl, a heterocyclic, or -OR₁ where R₁ can be alkyl of 1-12 carbon

atoms, aryl, alkaryl or aralkyl); -CN; -NR₂R₃ or $\text{---}\overset{\text{O}}{\underset{\parallel}{\text{C}}}\text{---NR}_2\text{R}_3$ (where R₂ and

and R₃ can be hydrogen, alkyl or cycloalkyl of 1-12 carbon atoms, aryl, alkaryl, aralkyl, -CH₂OR₄ (where R₄ is hydrogen, alkyl or cycloalkyl of 1-12 carbon atoms, aryl, alkaryl, aralkyl), or together R₂ and R₃ can form a heterocyclic ring);

$\text{---}\overset{\text{R}_5}{\underset{|}{\text{C}}}=\text{CR}_6\text{R}_7$ (where R₅, R₆ and R₇ can be hydrogen, alkyl or cycloalkyl of 1-12

carbon atoms, aryl, alkaryl, aralkyl, or -COOR or when taken together R₅, R₆ and/or R₇ can form a cyclic group); -SO₃H; a urethane group; an isocyanate or blocked isocyanate group; a

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urea group; an oxirane group; an aziridine group; a quinone diazide group; an azo group; an azide group; a diazonium group; an acetylacetoxy group; $-\text{SiR}_8\text{R}_9\text{R}_{10}$ (where R_8 , R_9 and R_{10} can be alkyl or cycloalkyl of 1-12 carbon atoms or $-\text{OR}_{11}$ where R_{11} is alkyl or cycloalkyl of 1-12 carbon atoms, aryl, alkaryl or aralkyl); or an $-\text{OSO}_3\text{R}_{12}$, $-\text{OPO}_2\text{R}_{12}$, $-\text{PO}_2\text{R}_{12}$, $-\text{PR}_{12}\text{R}_{13}\text{R}_{14}$, $-\text{OPOR}_{12}$, $-\text{SR}_{12}\text{R}_{13}$, or $-\text{N}^+\text{R}_{12}\text{R}_{13}\text{R}_{14}$ group (where R_{12} , R_{13} and R_{14} can be hydrogen, alkyl or cycloalkyl of 1-12 carbon atoms, aryl, alkaryl or aralkyl); or a salt or onium salt of any of the foregoing. Preferred functional groups are $-\text{COOH}$, $-\text{OH}$, $-\text{NH}_2$, an amide group, a vinyl group, a urethane group, an isocyanate group, a blocked isocyanate group or combinations thereof. Functional groups may be located anywhere on the branched polymer. However, it is sometimes desirable to choose comonomers which impart bulk polymer characteristics to the linear backbone segment of the branched polymer and

On page 17, line 17 amend as follows:

b4
Examples of components having protected acid groups that yield a carboxylic acid as the hydrophilic group upon exposure to photogenerated acid include, but are not limited to, A) esters capable of forming, or rearranging to, a tertiary cation, B) esters of lactone, C) acetal esters, D) β -cyclic ketone esters, E) α -cyclic ether esters, and F) MEEMA (methoxy ethoxy ethyl methacrylate) and other esters which are easily hydrolyzable because of anchimeric assistance. Some specific examples in category A) are t-butyl ester, 2-methyl-2-adamantyl ester, and isobornyl ester. Some specific examples in category B) are γ -butyrolactone-3-yl, γ -butyrolactone-2-yl, mevalonic lactone, 3-methyl- γ -butyrolactone-3-yl, 3-tetrahydrofuranyl, and 3-oxocyclohexyl. Some specific examples in category C) are 2-tetrahydropyranyl, 2-tetrahydrofuranyl, and 2,3-propylenecarbonate-1-yl. Additional examples in category C) include various esters from addition of vinyl ethers, such as, for example, ethoxy ethyl vinyl ether, methoxy ethoxy ethyl vinyl ether, and acetoxy ethoxy ethyl vinyl ether. Examples of components having protected hydroxyl groups that yield either a phenol or alcohol as the hydrophilic group upon exposure to photogenerated acid or base include, but are not limited to, t-butoxycarbonyl (t-BOC), t-butyl ether, and 3-cyclohexenyl ether.

On page 20, line 13 amend as follows:

b5
The photoresist compositions of this invention are sensitive in the ultraviolet region of the electromagnetic spectrum and especially to those wavelengths ≤ 367 nm. Imagewise exposure of the resist compositions of this invention can be done at many different UV wavelengths including, but not limited to, 365 nm, 248 nm, 193 nm, 157 nm, and lower wavelengths. Imagewise exposure is preferable done with ultraviolet light of 248 nm, 193 nm, 157 nm, or lower wavelengths; is more preferable done with ultraviolet light of 193 nm, 157 nm, or lower wavelengths; and is still more preferably done with ultraviolet light of 157 nm or lower wavelengths. Imagewise exposure can either be done digitally with a

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laser or equivalent device or non-digitally with use of a photomask. Suitable laser devices for digital imaging of the compositions of this invention include, but are not limited to, an argon-fluorine excimer laser with UV output at 193 nm, a krypton-fluorine excimer laser with UV output at 248 nm, and a fluorine (F2) laser with output at 157 nm. Since, as discussed supra, use of UV light of lower wavelength for imagewise exposure corresponds to higher resolution (lower resolution limit), the use of a lower wavelength (e.g., 193 nm or 157 nm or lower) is generally preferred over use of a higher wavelength (e.g., 248 nm or higher). Specifically, imaging at 157 nm is preferred over imaging at 193 nm for this reason.

On page 21, line 32 amend as follows:

GLOSSARY

Chemicals/Monomers

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AA	Acrylic acid Aldrich Chemical Co., Milwaukee, WI
1-AdA	1-Adamantyl acrylate
AIBN	2,2'-azobisisobutyronitrile Aldrich Chemical Co., Milwaukee, WI
AMS	alpha-Methyl styrene Aldrich Chemical Co., Milwaukee, WI
AMSD	alpha-Methyl styrene dimer Goi Chemicals Ltd., Houston, TX
BuAc	n-Butyl acetate Aldrich Chemical Co., Milwaukee, WI
DMG Co(III)	Isopropyl-bis(borondifluoromethylglyoximate)cobaltate (III)
Catalyst	E. I. du Pont de Nemours, Sydney, Australia
HEMA	2-Hydroxyethyl methacrylate Aldrich Chemical Co., Milwaukee, WI
HMDS	Hexamethyldisilazane Aldrich Chemical Co., Milwaukee, WI

On page 46, lines 28 and 36 amend as follows:

EXAMPLE 25

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A photoresist composition was made at 26% solids as in Example 22, except that 15.4 gm of a solution of the graft copolymer of Example 17 was used in place of the graft copolymer solution of Example 12, and 14.6 gm of PGMEA was used. The photoresist was processed as in Example 22 to give a positive image. Resist coating quality was cloudy and nonuniform, but it did develop in 60 sec., and better than the corresponding random polymer in Example 26.

EXAMPLE 26

A photoresist composition was made at 26% solids as in Example 22, except that 18.4 gm of a solution of the random copolymer of Example 18, which has the same overall composition of the graft copolymer of Example 17, was used in place of the graft copolymer

B7 solution of Example 12, and 11.6 gm of PGMEA was used. The photoresist was processed as in Example 22 to give a positive image. Resist coating quality was much poorer, and imaging/development was significantly poorer, than the graft copolymer in Example 25.

On page 53, in the first table on the page, amend as follows:

B8

	Parts by Weight	Grams
Portion 1		
tBMA		6.59
IBOMA		28.17
HEMA		6.59
MEK		49.45
Portion 2		
IBOMA		79.12
tBMA		26.37
HEMA		26.37
Portion 3		
Vazo® 52 Initiator		3.30
MEK		82.42
Total		300.00

On page 56, line 3 in the heading, amend as follows:

EXAMPLE 44


B9 Effect of Monomer Composition on Optical
Transparency in the EUV:

On page 57 in the second table on the page, amend as follows:

B10


	Parts by Weight	Grams
Portion 1		
Macromonomer (Example 45A)		169.56
Isobornyl acrylate (IBA)		25.52
Methyl acrylate (MA)		3.65
Acrylic acid (AA)		3.65
t-Butyl acrylate (tBA)		3.65
MEK		84.23

On page 59 in the table, amend as follows:



Parts by Weight	Grams
Portion 1	
Macromonomer (Example 45A)	169.56
Isobornyl acrylate (IBA)	30.98
Acrylic acid (AA)	5.47
MEK	84.23
Portion 2	
t-butyl peroxy pivalate	2.21
MEK	11.67
Portion 3	
Isobornyl acrylate (IBA)	138.30
Acrylic acid (AA)	24.41
Portion 4	
t-butyl peroxy pivalate	2.21
MEK	22.12
Portion 5	
t-butyl peroxy pivalate	4.42
MEK	4.42
Total	500.00

On page 60 in the table, amend as follows:



Parts by Weight	Grams
Portion 1	
Macromonomer (Example 45A)	169.56
Isobornyl acrylate (IBA)	23.69
Methyl acrylate (MA)	3.64
Acrylic acid (AA)	3.64
MEK	84.23
Portion 2	
t-butyl peroxy pivalate	2.21
MEK	11.67
Portion 3	
Isobornyl acrylate (IBA)	130.14

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Methyl acrylate (MA)	16.27
Acrylic acid (AA)	16.27
Portion 4	
t-butyl peroxyvalerate	2.21
MEK	22.12
Portion 5	
t-butyl peroxyvalerate	4.42
MEK	4.42
Total	500.00

On page 61 in the table, amend as follows:

B13

Parts by Weight	Grams
Portion 1	
Macromonomer (Example 45A)	169.56
Isobornyl acrylate (IBA)	23.69
Acrylonitrile	7.29
Acrylic acid (AA)	5.47
MEK	84.23
Portion 2	
t-butyl peroxyvalerate	2.21
MEK	11.67
Portion 3	
Isobornyl acrylate (IBA)	105.76
Acrylonitrile (AN)	32.54
Acrylic acid (AA)	24.41
Portion 4	
t-butyl peroxyvalerate	2.21
MEK	22.12
Portion 5	
t-butyl peroxyvalerate	4.42
MEK	4.42
Total	500.00

On page 62 in the table, amend as follows:

Parts by Weight	Grams
Portion 1	
Macromonomer (Example 45A)	169.56
Isobornyl acrylate (IBA)	36.45
MEK	84.23
Portion 2	
t-butyl peroxy pivalate	2.21
MEK	11.67
Portion 3	
Isobornyl acrylate (IBA)	162.70
Portion 4	
t-butyl peroxy pivalate	2.21
MEK	22.12
Portion 5	
t-butyl peroxy pivalate	4.42
MEK	4.42
Total	500.00

On page 63, line 16 amend as follows:

EXAMPLE 50

The following formulation was prepared and magnetically stirred overnight.

<u>Component</u>	<u>Wt. (gm)</u>
Copolymer described in Example 45, [70] IBA/MA/tBA/AA 70/10/10/10 // [30] MMA/tBMA/MAA 40/40/20, which had been solvent exchanged with PGMEA as follows. Thus, to 100.0 gm of the copolymer solution in Example 45B (60.3% Solids in MEK) was added 140.7 gm PGMEA, and rotary evaporated under vacuum to a net weight of 201.0 gm (30% Solids)	7.3
Propylene glycol methyl ether acetate (PGMEA)	5.3
Cyclohexanone	7.5
t-Butyl Lithocholate	2.18
5% (wt) solution of triphenylsulfonium	